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Topic Area: D2: Decision Support Tools for Multi-Level Analyses

Title: Multi-Level Analysis Framework

Objective:

The overall objective of this work will be to provide an integrated suite of software tools that can be used to create, analyze and display the results of various trade-off analyses algorithms that will be used to assist RSM managers in selecting optimal or near-optimal RSM decision scenarios.

The specific objective of this work unit and any follow-on work units will be to create a framework and software toolset that will allow RSM managers to use complex decision making algorithms to find the most cost effective and scientifically defensible RSM solutions. This framework will allow multiple decision models to be incorporated in a phased approach similar to the XMS modeling series. The software tools developed in this will be used to set-up and display the results of decision problems while the decision algorithms can be added or enhanced at a latter time under follow-on work units.

Benefits:

This work unit will create an integrated decision making framework that will allow the Corps to make better decisions regarding Regional Sediment Management. The first phase will be to integrate the modeling results from existing and newly developed (under task B) sediment transport analysis codes with data from various sources including COTS GIS database data as well as the RSM database tables created under task D1. These integrated tools will provide users with an enhanced data-browsing tool so that less time is spent finding, formatting and organizing data and more time spent analyzing the data to make better decisions. This first phase will closely follow the decision support paradigm developed for the Corps of Engineers Land Management System (LMS).

The decision modeling capabilities developed under this work unit will follow closely the modeling framework of the XMS modeling series. The tools developed under this work unit will allow the user to select and assign data to create a decision model and then use decision modeling software to evaluate the optimal or near-optimal solution.

These tools will work in conjunction with the decision support framework (D2.1), the decision support visualization tools (D2.2) and the RSM database tools (D1) to provide Corps managers in charge of regional sediment management the necessary tools to perform meaningful alternative analysis. These alternatives could include comparisons between regional and local scale models, comparisons between different land use scenarios, Monte Carlo simulations for integrating stochastic or probabilistic variability into the decision and optimization tools for finding the "best" solution given specific constraints. This work will provide Corps managers a suite of tools for determining the most effective method for managing sediment.

Work Description:

The work for this work unit will be conducted in three primary stages. During the first phase, work will be conducted to assess and enhance existing software tools with the ability to incorporate RSM specific GIS data, RSM database information, real-time RSM

sensory data as well as analytic modeling results into a seamless, Internet-enabled data browsing environment. This will entail close interaction with the data mining work unit and the RSM database work unit. A short list of existing sediment modeling analysis tools will be created using the existing model catalog developed for LMS. The I/O requirements for each model will be assessed to determine the applicability of creating I/O translators. During funded year 1, an I/O translator will be developed to read model result in native format, re-formulate them to fit the RSM database guidelines (from task D1) and write them to a database built upon those standards. Under subsequent work units, if appropriate, an I/O translator can be developed for most models in the model catalog. Also during the first funded year, the existing LMS decision support GUI will be modified to read/write to an RSM qualified database and will therefore be able to visualize RSM model output stored in that format. In subsequent years, the Decision Support GUI will be modified to support additional RSM specific Decision Support tasks. Specifically a beta system will be fielded to a select group of district offices as a field test. Modifications and enhancements recognized during this beta test will be integrated into the decision support system and a final version fielded in 4Q/YR2.

The second phase will focus on creating a software toolset to set-up a decision model for trade-off analyses. The software tools will allow the user to access multiple existing decision models that will evaluate various decision possibilities and suggest optimal or near-optimal solutions based on the objective and constraint criteria provided by the user. The specific decision model which may be used include closed-form optimization, heuristic optimization (potentially including tabu-search, fuzzy logic and evolutionary computing algorithms), and Monte-Carlo simulation or other stochastic algorithms. Each decision model can be integrated into the framework under additional work units as needs and budget permit. This work unit will initially incorporate a simplistic vanilla heuristic decision model to facilitate the development of the analysis framework while additional decision models can be added under follow-on work units. This work will rely heavily on the standard RSM database design created in work unit D1. These tools will include the methodology to set-up an RSM optimization equation and then select and perform an optimization analysis. This work will be completed at 4Q/YR3.

An important aspect of these tools will be the incorporation of knowledge management tools. These tools hold the promise of providing information on the effectiveness of past RSM projects as well as helping determine the most likely candidate solutions to solve specific RSM problems. Specific tools such as rule-based expert systems and other knowledge management tools may be incorporated. As a final phase, work will be conducted to incorporate knowledge management tools that can aid RSM managers in selecting the most promising solutions for specific RSM problems.

Follow-on Projects:

The primary purpose of this work-unit is to establish a framework from which additional RSM decision support activities can proceed. Once the framework has been created and validated as described in the work description above, additional features will be added to enhance the capabilities of the tools. This follow-on work will include the creation of additional I/O translators so that more analytic models can interact with the RSM database and hence be used by the analysis framework tools. The follow-on work will also include the addition of more decision models so that more sophisticated trade-off analyses can be performed.

Products:

<i>Product</i>	<i>Scheduled</i>
Begin Adapting Visualization Tools	Q1/02
Create RSM Model Catalog	Q2/02
Model I/O assessment	Q4/02
Complete I/O Translator for Initial Model	Q2/03
Field beta RSM Decision Support GUI	Q2/03
Completing of RSM Decision Support GUI – Fielded System	Q4/03
Begin work on decision model framework	Q1/03
Complete decision model framework	Q4/04
Incorporate Knowledge Management Tools	Q4/04